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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF : Zuoxing Yu, et al.

FOR

MOISTURE CROSSLINKABLE THERMOPLASTICS
IN THE MANUFACTURE OF VEHICLE WEATHER
STRIPS

SERIAL NO.

09/912,099

FILED

July 24, 2001

GROUP ART UNIT

1773

EXAMINER

AHMED, Sheeba

LAST OFFICE ACTION

April 9, 2003

ATTORNEY DOCKET NO.:

CSAZ 2 00145

Cleveland, Ohio 44114-2518

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JUL 10 2003
TC 1700TRANSMITTAL OF
RULE 37 C.F.R. §1.192 APPELLANT'S BRIEF

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicant transmits herewith three (3) copies of a RULE 37 C.F.R.
§1.192 APPELLANT'S BRIEF for the above-referenced patent application.

CERTIFICATE OF EXPRESS MAILING

I hereby certify that this Rule 37 C.F.R. §1.192 Appellant's Brief is being sent by the United States Postal Service via Express Mail procedure in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, Mail Stop Appeal Brief-Patents. Express Mail No.: EV341151357US.

By: Cathryn Ferchek
Cathryn Ferchek

Date: July 2 2003



U.S. Serial No. 09/943,606
Attorney Docket No.: CSAZ 2 00146

A check in the amount of \$320.00 is enclosed for filing the Brief. If any additional fees are due, the Commissioner is authorized to charge Deposit Account No. 06-0308.

Respectfully submitted,
FAY, SHARPE, FAGAN,
MINNICH & McKEE, LLP

Date: July 2, 2003

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PATENT
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TC 1700**RULE 37 C.F.R. §1.192 APPELLANT'S BRIEF**

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This Appeal Brief is in furtherance of the Notice of Appeal mailed April 30, 2003 and that was received by the U.S. Patent and Trademark Office on May 6, 2003.

The fees required under 37 C.F.R. §1.17 and any required petition for extension of time for filing this Brief and fees therefore are dealt with in the accompanying Transmittal of Appeal Brief.

Appellant files herewith an Appeal Brief in connection with the above-identified application wherein claims 21-29 were finally rejected in the final Office Action mailed January 30, 2003. What follows is Appellant's Appeal Brief (submitted in triplicate) in accordance with 37 C.F.R. §1.192(a).

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CERTIFICATE OF EXPRESS MAILING

I hereby certify that this Rule 37 C.F.R. §1.192 Appellant's Brief is being sent by the United States Postal Service via Express Mail procedure in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, Mail Stop Appeal Brief-Patents. Express Mail No.: EV341151357US.

By: *Cathryn Terchek*
Cathryn TerchekDate: *July 2 2003*

I. Real Party in Interest (37 C.F.R. §1.192(c)(1))

The real party in interest in the subject Appeal is the Assignee, Cooper Technology Services LLC.

II. Related Appeals and Interferences (37 C.F.R. §1.192(c)(2))

Currently it is believed that there are no other appeals or interferences in process or pending before the U.S. Patent and Trademark Office which the present application bases its priority from, or any case which bases its priorities upon the present application, that will directly affect or will be directly affected by, or will have a bearing on the Board's decision in this Appeal.

III. Status of Claims (37 C.F.R. §1.192(c)(3))

The status of the claims set forth after the final Office Action mailed January 30, 2003, and the Advisory Action mailed April 9, 2003, was and is as follows: allowed claims: **none**, rejected claims: **21-30**. The present Appeal is directed specifically to claims 21-30. Appellants would like to point out that the Examiner indicated that the After Final Amendment under 37 C.F.R. §1.116, which added new claim 30, was entered. However, the Advisory Action only indicates that claims 21-29 are pending. Appellants assume this number is in error and that the Examiner meant to indicate that claims 21-30 are pending.

IV. Status of the Amendments (37 C.F.R. §1.192(c)(4))

Amendments to the claims made in an After Final Amendment filed March 26, 2003 were entered as indicated in the Advisory Action mailed April 9, 2003. All submitted amendments have been entered. However, see above comment as to status of claims.

V. Summary of the Invention (37 C.F.R. §1.192(c)(5))

The present application is directed to a wear resistant composite extrusion including a decorative layer comprising an at least partially crosslinked thermoplastic, bonded to an at least partially crosslinked thermoset elastomer rubber main body member, wherein the thermoplastic is selected from the group consisting of a moisture crosslinkable ethylene-a-olefin copolymer and a moisture crosslinkable copolymerized ethylene-styrene interpolymer (claims 21 and 29, page 3, lines 20 to page 4, line 13). The moisture crosslinkable ethylene-a-olefin copolymer may be a silane grafted ethylene-octene copolymer (claim 22, page 9, lines 20-21). The thermoset elastomer rubber may be an EPDM rubber (claim 23, page 7, lines 4-5). The abrasion resistant decorative layer may be a sheet member (claim 24, page 16, lines 7-8). The sheet member may be laminated and bonded to the main body member (claim 25, page 16, lines 14-16). In the present invention the thermoset elastomer rubber may be extruded at a temperature of about 110°C, the crosslinked thermoplastic may be extruded at a temperature of 200°C to about 260°C, the crosslinked thermoplastic may be at least partially cured in a steam or water bath maintained at a temperature of from about 60°C to about 110°C, and the thermoset elastomer rubber may be at least partially cured at a temperature of from about 180°C to about 270°C (claims 26 and 29, page 13, line 12, page 14, line 20). The thickness of the abrasion resistant layer may be from about 0.1 to about 1.5 mm (claim 27, page 14, lines 1-3). More preferably, the thickness of the abrasion resistant layer is about 0.5 mm (claim 28, page 14, lines 1-3).

VI. Issues (37 C.F.R. §1.192(c)(6))

Whether claims 21 and 24-29 are anticipated under 35 U.S.C. §102(e) by U.S. Patent No. 6,110,546 to Honda, et al. (Honda).

Whether claims 22, 23 and 30 are unpatentable under 35 U.S.C. §103(a) as being unpatentable over Honda in view of U.S. Patent 3,646,155 to Scott, et al. (Scott).

VII. Grouping of Claims (37 C.F.R. §1.192(c)(7))

Claims 21-30 do not stand or fall together. More specifically, claims 21, 22 and 26 recite separately patentable subject matter. This is explained in detail below.

Claim 21 recites a composite extrusion having an at least partially crosslinked thermoplastic decorative layer bonded to a crosslinked thermoset elastomer main body member. Claims 22 and 26 contain additional recitations further defining the at least partially crosslinked thermoplastic, as well as the conditions under which the composite extrusion was manufactured. These recitations are mirrored in claims 29 and 30 as well. Even assuming for purposes of argument that claim 21 is rendered unpatentable by the prior art, claims 22 and 26 contain additional recitations that may serve as patentable distinction over the prior art. That is, even assuming that claim 21 is determined to be unpatentable, claims 22 and 26 are still patentably distinguished over the prior art due to their additional recitations which are not disclosed or suggested in the prior art of record. For this reason, at least claims 21, 22 and 26 all recite separately patentable subject matter.

VIII. Arguments (37 C.F.R. §1.192(c)(8))

A. The Examiner's rejection of claims 21 and 24-29 under 35 U.S.C. §102(e) as being anticipated by Honda is improper and must be reversed.

The Examiner rejected claims 21 and 24-29 under 35 U.S.C. 102(e) as being anticipated by Honda. Applicants respectfully disagree that the claims of the present invention are unpatentable over Honda.

As previously detailed, Honda discloses an automobile weatherstrip including a weatherstrip body formed from a rubber polymer and a decorative layer formed from a thermoplastic elastomer (TPE) and hydrotalcite as a discoloration preventing agent. The rubber polymer of the weatherstrip body can comprise, for example, a sulfur vulcanize-ethylene- α -olefin non-conjugated-diene copolymer rubber (EODM). The thermoplastic elastomer of the decorative layer can be an olefinic thermoplastic elastomer (TPO) or a styrenic thermoplastic elastomer (TPS). If the TPE

is a TPO, then the TPO comprises an olefinic resin and an ethylene- α -olefinic copolymer rubber (col. 4, lines 11-13). The olefinic resin can include polypropylene, polyethylene and copolymers of propylene. The ethylene- α -olefinic copolymer rubber of the TPO can include ethylene- α -olefinic copolymer rubbers (EOR). The EOR can have a crosslinked, partially crosslinked or non-crosslinked structure (col. 4, lines 63-67).

Independent claims 20 and 29, from which the remainder of the rejected claims depend, recite a composite extrusion having an at least partially crosslinked thermoplastic decorative layer wherein said thermoplastic is selected from the group consisting of a moisture crosslinkable ethylene- α -olefinic copolymer and a moisture crosslinkable copolymerized ethylene-styrene copolymer bonded to an elastomer rubber main body member.

The cited claims of the present application are not anticipated by the Honda patent. In order to properly reject a claim under §102, each and every element of the claimed subject matter must be disclosed in a single prior art reference. Here, even assuming that the other elements of the present invention and the Honda patent are the same, the composition of the claimed decorative layer is significantly different than the teachings of Honda.

The decorative layer of Honda comprises a two-phase thermoplastic elastomer blend of a olefinic resin and then elastomer rubber. This is in contrast to the present invention which includes a decorative layers comprising a crosslinkable thermoplastic. This crosslinkable thermoplastic is a single-phase thermoplastic copolymer to which silane groups have been grafted to effect crosslinking in the presence of water (page 9, lines 10 to page 12, line 3). Thermoplastics are chemically distinct from thermoplastic elastomers. Thermoplastic elastomers are multi-phased compositions in which the phases are intimately dispersed. The thermoplastic elastomers of Honda are blends of a hard thermoplastic with a soft elastomer rubber polymer. It is clear from Honda that only the rubber-phase is crosslinked (col. 4, lines 63 to col. 5, line 5).

As detailed above, Honda discloses a TPO including an ethylene- α -olefin

copolymer rubber. The present invention, on the other hand, recites a weather strip having a decorative layer comprising a moisture crosslinkable thermoplastic. This thermoplastic may be an ethylene- α -olefin thermoplastic. Although Honda does disclose the use of an ethylene- α -olefin copolymer for use in the decorative layer described therein, these compositions as described in Honda are such as to render them rubbers rather than thermoplastics as claimed in the present invention. In addition, there is no indication that the olefinic resin, which is the only material that may be properly described as a thermoplastic in Honda, can be at least partially crosslinked as required by the present claims (see col. 4, lines 16-27). Thus, because Honda fails to disclose a decorative layer comprising an at least partially crosslinked thermoplastic, it fails to anticipate the present claims.

Further, Honda fails to disclose a moisture crosslinkable polymeric compound. In this respect, Honda does disclose that the ethylene- α -olefin copolymer rubbers may be crosslinked. However, Honda only discloses the use of peroxide as a crosslinking agent (col. 4, lines 63-68, and col. 5, lines 1-5). As is known in the art, peroxide crosslinking agents are not moisture crosslinking agents. Thus, Honda fails to disclose a moisture crosslinkable thermoplastic for use as the decorative layer. For at least these reasons, Honda fails to anticipate the present claims.

The Examiner attempts to dismiss the distinction between the crosslinkable thermoplastic of the present invention and the thermoplastic elastomer of Honda by stating ". . . Honda et al. specifically disclose a decorative layer that comprises a **thermoplastic** elastomer such as an olefin thermoplastic elastomer (TPO) or a styrene thermoplastic elastomer (TPS). The TPO comprises an ethylene-alpha-olefin copolymer rubber wherein the ethylene-alpha-olefin copolymer rubber can have a partially-crosslinked structure and hence the limitations of the claimed invention have been met." (final Office Action, page 2).

The Examiner is missing the fundamental distinction between the crosslinked ethylene- α -olefin copolymer rubber of the TPO of Honda and the crosslinkable thermoplastic of the present invention. Although both compounds are

ethylene- α -olefin copolymers, the compound in Honda is a rubber, whereas the compound of the present application is a thermoplastic. Ethylene- α -olefin copolymer rubbers differ from ethylene- α -olefin copolymer thermoplastics in several important ways. First, the crystallinity is quite different between the two compounds. Ethylene- α -olefin rubbers (such as ethylene-propylene rubber) are random copolymers of ethylene and an alpha-olefin. They are non-crystalline materials used for toughening other polymers usually having typical glass transition temperatures of -30°C or lower. Ethylene-propylene thermoplastics, on the other hand, are typically stereospecific (isotactic) and have a greater degree of crystallinity. They are rigid compositions having a much higher glass transition temperature. To call attention to the differences between ethylene- α -olefin thermoplastics and ethylene- α -olefin rubbers (elastomers), a copy of Table 8.1 from Polymer Chemistry by Malcolm P. Stevens is attached as Appendix B. This table highlights and acknowledges the difference between ethylene-propylene plastics and ethylene-propylene copolymer elastomers. Thus, despite the Examiner's arguments, Appellants submit that the crosslinkable ethylene- α -olefin rubber of the TPO in Honda is not the same as the ethylene- α -olefin copolymer thermoplastic used as the decorative layer in the present application. For at least these reasons Honda fails to anticipate the present claims.

Further, and with respect to claim 26, Honda fails to disclose the extrusion and curing temperatures for the thermoset elastomer rubber and the crosslinked thermoplastic.

B. The Examiner's rejection of Claims 22, 23 and 30 under 35 U.S.C. §103(a) as being unpatentable over Honda in view of Scott is improper and must be reversed.

The Examiner rejected claims 22 and 23 under 35 U.S.C. §103(a) as being unpatentable over Honda in view of Scott. Appellants respectfully disagree that the claims of the present invention are obvious over Honda in view of Scott.

The pertinent portions of the disclosure of Honda are set forth above. Scott discloses a process for crosslinking a polyolefin by grafting silane functional groups to the polymer background and subsequently exposing the product to moisture in the presence of a silanol condensation catalyst. Scott discloses one method in which the moisture crosslinkable thermoplastics in the present invention may be crosslinked.

Initially, there is no motivation to combine the two references. To properly combine references under 35 U.S.C. §103(a), there must be some suggestion or motivation to do so. Here, the Examiner states that Scott teaches "the crosslinking of olefin copolymer using a silane compounds such that the crosslinking may be carried out in two stages and yields a product that has extremely high resistance to stress cracking and could be employed in extruded articles. Accordingly, it would have been obvious to one having ordinary skill in the art to crosslink the ethylene-octene copolymer disclosed by Honda et al. with a silane compound given that Scott et al. specifically teach that doing so yields a product that has extremely high resistance to stress cracking and could be employed in extruded articles."

The Examiner improperly relies on the disclosure of Scott in making the above statement. As stated in column 5, lines 14-17, of Scott "[c]ross-linked polyolefins produced according to this invention are characterized by physical properties which are comparable to those obtained by conventional methods i.e. by organic peroxide cross-linking." (emphasis added). Thus the resistance to stress cracking in crosslinked polyolefins is no greater when using the silane compound disclosed in Scott as compared to using an organic peroxide crosslinking method. Thus, the silane crosslinking disclosed in Scott would provide no additional motivation for one seeking to improve stress cracking resistance in an extruded polyolefin.

Further, there is no indication in Honda that superior stress cracking resistance is desired. Honda simply seeks to provide an automobile weatherstrip which is both economical to produce and does not undergo discoloration (col. 1, lines 53-55). Thus, one practicing the invention of Honda would not be motivated to increase the resistance to stress cracking in the weatherstrips. Similarly, even assuming the

presence of such motivation, there would be no suggestion to apply the teachings of Scott in the manufacture of such weatherstrips since, as discussed above, the method disclosed in Scott only provides crosslinked polyolefins having comparable properties to those obtained via conventional crosslinking methods.

The Examiner does not address the above arguments in the Advisory Action and continues to maintain that Scott specifically teaches that the crosslinking of olefin copolymers using a silane compound yields a product that has extremely high resistance to stress cracking and that it would have been obvious to one having ordinary skill in the art to crosslink the ethylene-octene copolymer of Honda with a silane compound to yield a product that has extremely high resistance to stress cracking. As detailed above, however, the physical properties provided by silane crosslinking are no greater than using an organic peroxide crosslinking method. Appellants maintain that even assuming one practicing the invention of Honda would seek to improve stress cracking resistance, such a person skilled in the art would not look to the teachings of Scott since Scott admits that the physical properties of a silane crosslinked polyolefin are comparable to those obtained by conventional methods. One would not seek to use the teachings of Scott if no physical benefits over the prior art methods are realized. The Examiner's argument is simply not persuasive.

Finally, even if the references could somehow be combined, they would not meet all the recitations of the present claims. As detailed above, Honda clearly fails to disclose a crosslinkable thermoplastic. It only discloses a crosslinkable ethylene- α -olefin copolymer rubber. Thus, even if there was proper motivation to combine the two references, the most such a combination would disclose would be a silane grafted crosslinkable ethylene- α -olefin rubber, which is clearly distinguishable from the crosslinkable thermoplastic of the present claims. For at least these reasons, the combination of Honda and Scott fails to render the present claims unpatentable under 35 U.S.C. §103(a).

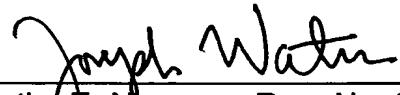
CONCLUSION

In view of the foregoing, Appellants respectfully submit that claims 21-30 are not rendered obvious by the cited art, either alone or in combination. Accordingly, it is respectfully requested that the Examiner's rejections be reversed.

Respectfully submitted,

FAY, SHARPE, FAGAN,
MINNICH & McKEE, LLP

Date: July 2, 2003



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IX. Appendix of Claims (37 C.F.R. §1.192(c)(a))

21. A wear resistant composite extrusion suitable for use as a vehicle weather strip including an abrasion resistant decorative layer comprising an extruded and at least partially crosslinked thermoplastic, wherein said thermoplastic is selected from the group consisting of a moisture crosslinkable ethylene- α -olefin copolymer and a moisture crosslinkable copolymerized ethylene-styrene interpolymer, bonded to and disposed immediately adjacent an extruded and at least partially crosslinked thermoset elastomer rubber main body member.

22. The composite extrusion according to claim 21, wherein said moisture crosslinkable ethylene- α -olefin copolymer is a silane grafted ethylene-octene copolymer.

23. The composite extrusion according to claim 22, wherein said thermoset elastomer rubber is an EPDM rubber.

24. The composite extrusion according to claim 21, wherein said abrasion resistant decorative layer is a sheet member.

25. The composite extrusion according to claim 24 wherein said sheet member is laminated and bonded to said main body member.

26. The composite extrusion according to claim 21, wherein said thermoset elastomer rubber has been extruded at a temperature of about 110°C, said crosslinked thermoplastic has been extruded at a temperature of 200°C to about 260°C, said crosslinked thermoplastic has been at least partially cured in a steam or water bath maintained at a temperature of from about 60°C to about 110°C, and said thermoset elastomer rubber of said main body member has been at least partially cured at a temperature of from about 180°C to about 270°C.

27. The composite extrusion according to claim 21, wherein the thickness of said abrasion resistant layer is from about 0.1 to about 1.5 mm.

28. The composite extrusion according to claim 27, wherein the thickness of said abrasion resistant layer is about 0.5 mm.

29. A wear resistant composite extrusion suitable for use as a vehicle weather strip including an abrasion resistant decorative layer comprising an extruded and at least partially crosslinked thermoplastic, said thermoplastic selected from the group consisting of a moisture crosslinkable ethylene- α -olefin copolymer and a moisture crosslinkable copolymerized ethylene-styrene interpolymer, bonded to and disposed immediately adjacent an extruded and at least partially cured thermoset elastomer rubber main body member, wherein said thermoset elastomer rubber has been extruded at a temperature of about 110°C, said crosslinkable thermoplastic has been extruded at a temperature of 200°C to about 260°C, and said crosslinkable thermoplastic has been at least partially crosslinked in a steam or water bath maintained at a temperature of from about 60°C to about 110°C, and further wherein said abrasion resistant decorative layer is about 0.3 to about 0.7 mm thick.

30. The composite extrusion according to claim 29, wherein said moisture crosslinkable ethylene- α -olefin copolymer is a silane grafted ethylene-octene copolymer.

APPENDIX B

THIRD EDITION

POLYMER CHEMISTRY

AN INTRODUCTION

Malcolm P. Stevens

University of Hartford

New York Oxford

OXFORD UNIVERSITY PRESS

1999

A variety of commercial products are prepared with Ziegler-Natta catalysts in addition to the HDPE and LLDPE mentioned above. Noteworthy is polypropylene, which cannot be made in sufficiently high molecular weight using free radical or ionic initiators, but which has achieved the status of commodity plastic in its predominately isotactic stereochemistry. Atactic polypropylene, a byproduct of isotactic polypropylene synthesis, is used for modifying asphalt roofing compounds. Other complex catalysts—*reduced metal oxides* and the sodium-based *alfin* catalysts—have been used to manufacture polyethylene and polydienes, respectively. Also certain tungsten- and other transition metal-based catalysts that promote double bond redistribution reactions are used to make commercial polymers from cycloalkenes. Plastics and elastomers manufactured with these various complex coordination catalysts are listed in Table 8.1.

Ziegler-Natta systems are by far the most important of the complex coordination catalysts, with commercial polymer production dating to the 1960s. Over the years many different Ziegler-Natta catalysts have been investigated, both insoluble (heterogeneous) and soluble (homogeneous). The latter, consisting primarily of transition metals sandwiched between cyclopentadiene rings, were not at first considered practical for industrial use because they were not sufficiently active. This changed in the 1980s when it was discovered that catalyst activity could be greatly enhanced by the addition of cocatalysts derived from the reaction of aluminum alkyl with water. As a consequence the “pi sandwich” *metallocenes* have become the object of intense research activity because, in addition to their high catalytic activity, they have been found to offer unprecedented control of polymer stereochemistry. Polymers and copolymers based on metallocene technology, including syndiotactic polystyrene, are already in commercial production, and others, such as syndiotactic polypropylene, are poised to enter the marketplace.

Before we proceed with the fundamentals of complex coordination polymerization, it is worth recalling that Ziegler and Natta shared the Nobel Prize in Chemistry in 1963.

TABLE 8.1. Commercially Available Polymers Synthesized with Complex Coordination Catalysts

Polymer	Principal Stereochemistry	Typical Uses
Plastics		
Polyethylene, high density (HDPE)	—	Bottles, drums, pipe, conduit, sheet, film, wire and cable insulation
Polyethylene, ultrahigh molecular weight (UHMWPE)	—	Surgical prostheses, machine parts, heavy-duty liners
Polypropylene	Isotactic	Automobile and appliance parts, rope, cordage, webbing, carpeting, film
Poly(1-butene)	Isotactic	Film, pipe
Poly(4-methyl-1-pentene) ^a	Isotactic	Packaging, medical supplies, lighting
Polystyrene	Syndiotactic	Specialty plastics

continued

TABLE 8.1. (continued)

Polymer	Principal Stereochemistry	Typical Uses
1,4-Polybutadiene	<i>trans</i>	Metal can coatings, potting compounds for transformers
1,4-Polyisoprene	<i>trans</i>	Golf ball covers, orthopedic devices
Ethylene-1-alkene ^b copolymer (linear low-density polyethylene, LLDPE)	—	Blending with LDPE, packaging film, bottles
Ethylene-propylene block copolymers (polyallomers)	Isotactic	Food packaging, automotive trim, toys, bottles, film, heat-sterilizable containers
Polydicyclopentadiene ^c	—	Reaction injection molding (RIM) structural plastics
Elastomers		
1,4-Polybutadiene	<i>cis</i>	Tires, conveyor belts, wire and cable insulation, footware
1,4-Polyisoprene	<i>cis</i>	Tires, footware, adhesives, coated fabrics
Poly(1-octenylene) (polyoctenamer) ^c	<i>trans</i>	Blending with other elastomers
Poly(1,3-cyclopentenylenevinylene) (norbornene polymer) ^c	<i>trans</i>	Molding compounds, engine mounts, car bumper guards
Polypropylene (amorphous)	—	Asphalt blends, sealants, adhesives, cable coatings
Ethylene-propylene copolymer (EPM, EPR)	—	Impact modifier for polypropylene, car bumper guards
Ethylene-propylene-diene copolymer (EPDM)	—	Wire and cable insulation, weather stripping, tire side walls, hose, seals

^aUsually copolymerized with small amounts of 1-pentene.

^b1-Butene, 1-hexene, and 1-octene.

^cSynthesized by ring-opening metathesis polymerization of the corresponding cycloalkene.

8.2 Heterogenous Ziegler-Natta Polymerization

8.2.1 Heterogenous Catalysts

The number of compounds and combinations of compounds that fit into the category of Ziegler-Natta catalysts^{3,5} are far too numerous to describe here, but a Ziegler-Natta catalyst may be defined as a combination of (1) a transition metal compound of an element from groups IV to VIII, and (2) an organometallic compound of a metal from groups I to III of

the periodic table organometallic co-

Most common vanadium, chromium, some instances, a that have been ir. Cocatalysts are usually tin, cadmium, be. are combinations

Catalysts are of oxygen, usual toward many nor gree of stereoreg for maximum ac TiCl₄-AlR₃ (R = (8.1 to 8.3). Orga bond cleavage {

Further reduc-

In addition, TiC

Radicals formed action with sol known to what the heterogene-

Although there are four different com mers having a hetered crystal str atactic polymer of the catalyst. tors: the nature ditives. Some r